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Title: Method for preventing damage from thrips

SPECIFICATION

1. TITLE OF THE INVENTION

METHOD FOR PREVENTING DAMAGE BY THRIPS

2. SCOPE OF THE CLAIM

A method for preventing the damage by thrips wherein a white fine powder of mineral having average particle diameter of 0.1 to 2.5 μ mixed with a fixing agent is sprayed at a solid concentration of 2 kg or less per 40 liters of water.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method for preventing damage from thrips (scirtothrips dorsalis) which inflicts damage to citrus fruits.

The thrips (scirtothrips dorsalis) is a noxious insect which proliferates in other plants than citrus (particularly tea plant), the imagoes thereof come flying to citrus fruits,

and fruits of citrus unshiu, navel orange, citrus hassaku, etc. suffer bruises in a ring form at the calyx portions thereof or grayish brown bruises at the centers of the top portions thereof from June of the juvenile stage of the fruits to October, thus to impair the commercial value thereof. It is a crucial insect pest which has been more and more increasing the damage therefrom all over the areas of citrus fruit culture in recent years.

As a means of exterminating this thrips, usually together with the prevention of melanose, spraying of organosulfurous agents such as mancozeb agent or spraying of insecticides such as acephate agent and dimethoate-fenvalerate agent has been carried out.

However, because the thrips breed frequently throughout the year and they cause damage over a long period of time(June to October), the number of spraying of the insecticides described above which have the residual effect of a relatively short term must be increased, inevitably resulting in an increased cost for the extermination.

Furthermore, although the breeding pattern of the thrips is shifting to an autumn multiple-breeding type in recent years, the mancozeb agent restricted in time usable cannot be used when the harvest of the fruits is close at hand, which results in excessive use of the insecticides described above. Consequently, the thrips acquire resistance to the insecticides, which gradually reduces the repelling effect of the

insecticides.

Under the circumstances, a method for preventing the damage from the thrips without relying upon insecticides has been investigated. The method utilizes the thrips' habit of avoiding white color, and a white fine powder of mineral is sprayed and fixed on citrus leaves to decrease the population of thrips coming flying, thus preventing the damage.

This method can be said as epoch-making as it depends upon physical action and it is difficult for the thrips to acquire the resistance. However, the method fails to have a sufficient repelling effect at the present conditions and has the disadvantage of producing damage from the chemicals in some cases because of excessive fixation thereof, which results in deterring its practical use for preventing the damage from the thrips.

The present inventors have been studied for a long period of time to remove such drawbacks toward practical use, and as a result, found that it is highly effective in prevention of the damage from the thrips to blend a white fine powder of mineral having average diameter of 0.1 to 2.5 μ with a fixing agent and to spray the blend at a solid concentration of 2 kg or less per 40 liters of water, the present invention having been thus accomplished.

The feature of the present invention is that the spraying at such low concentrations which exert little bad influence on

citrus leaves ensures a sufficiently practical effect of preventing the damage from thrips.

This method induces no problems of toxicity to fish as well as that to men and beasts and environmental pollution, and by using the method in combination with the conventional insecticides as described above, a delay in the appearance of the resistance to the insecticides may be expected. In addition, as minerals to be used occur in nature in large quantities, this method is relatively inexpensive and can be expected to reduce the prevention costs.

Furthermore, the method is advantageous in that an effect of decreasing the damage from chemicals may also be expected by use of calcium carbonate as the fine powder of mineral, for example, by spraying a mixture thereof with an inorganic copper wettable powder.

As the application form of the method of the present invention, a single form of a wettable powder or paste may be ready, or a white fine powder of mineral or wettable powder thereof may be blended with a fixing agent immediately before use.

The white fine powders of mineral include calcium carbonate, clay, kaolin, zieklite, china clay, talc, titanium white, zinc oxide, lithopone, chalk, slaked lime, etc. where they suitably have average particle diameter of 0.1 to 2.5 μ.

The fine powders of mineral described above may be used,

singly or as a mixture of two or more thereof, but in preparation of formulations, those having as high concentration as possible are advantageous in costs.

The role of the fixing agents used in the method of the present invention is to prevent the fine powder of mineral sprayed and fixed on citrus leaves from being washed away by rain and to maintain the repelling effect for a certain period of time, preferably for about 20 to 30 days. However, excessive use of the fixing agents, although it strengthens resistance to rain, adversely causes a reduction in reflectance of the leaves relating to the repelling effect. In addition, damages from the fixing agents caused by the inhibition of photosynthesis or the clogging of breathing pores of the leaves may be produced, and therefore, it is desirable to measure the reflectivity of leaf surfaces to use a suitable amount of fixing agent.

The fixing agents include high polymers termed adhesives or film-forming agents such as vinyl acetate resin, acrylic resin, petroleum resin, chlorinated rubber, PVA, polybutene, CMC, sodium alginate, casein soda, starch, dextrin, tragacanth gum, etc.

The fixing agents described above can be used, singly or as a mixture of two or more thereof.

Furthermore, anionic or nonionic surface active agents can be added in order to improve the dispersibility or diffusing

power on the surfaces of citrus leaves.

When the formulations are used in the paste form, small amounts of antifreezing agent such as ethylene glycol or calcium chloride and of antiseptic agent such as salicylic acid can be added to the paste.

The present invention is further illustrated through examples and test examples below.

EXAMPLE 1

Formulation A:

Fine Calcium Carbonate	
(Average Particle Diameter: 0.5 μ)	97%
Demor EP Powder	2%
Xanthane Gum	1%

The above mixture was pulverized and mixed in the ratio as described above in an atomizer to obtain a wettable powder.

Formulation B:

Sumikaflex #400	
(50% Vinyl Acetate Emulsion)	100%

When used, 0.5 to 2 kg of formulation A, 50 to 100 grams of formulation B, and 40 liters of water were well stirred and mixed before spraying.

EXAMPLE 2

Fine Clay	
(Average Particle Diameter: 2.0 μ)	50%
Movinyl DM 2 H (Vinyl Acetate/Maleic	

Acid Ester Copolymer Resin Emulsion)	20%
PVA	1%
Silicone Resin Emulsion (34.5%)	0.2%
Water	28.8%

The above mixture was placed in a kneader in the ratio as described above and mixed for 30 minutes to obtain a viscous paste. The paste is diluted 10 to 50 times with water before spraying.

EXAMPLE 3

Fine Calcium Carbonate	
(Average Particle Diameter: 0.5 μ)	87%
Movinyl DM200 (Vinyl Acetate/Peopa	
Copolymer Resin Powder)	10%
Demor N	3%

The above mixture was pulverized and mixed in an atomizer in the ratio as described above to obtain a wettable powder. The powder was added in an amount of 0.5 to 2 kg per 40 liters of water, and well stirred and mixed before spraying.

TEST EXAMPLE 1

In order to investigate the relation between the repelling action of fine mineral powders assuming white color in appearance and are different in particle diameter against thrips and the reflectivity of the leaf surface, 100 grams of vinyl acetate emulsion were added to 1, 2, 3, and 4 kg of five sorts of calcium carbonate shown in Table 1 which are different

in particle diameter and whiteness, diluted with 40 liters of water, and well stirred and mixed to prepare the spraying liquids, respectively. Sufficiently unfolded surfaces of citrus unshiu spring leaves which were nearly equal in size were sprayed with a fixed amount (to an extent that the leaf surfaces were slightly covered) of the liquids with a handspray from a distance of 1 meter, then air dried. The reflectance (integrated) of the leaf surfaces was then measured in the wavelengths ranging from 380 to 430 nm by use of an integrating sphere reflection instrument (manufactured by Shimadzu Corp.). Results are shown in Fig. 1 given later.

Table 1

Calcium Carbonate	Average Particle Diameter	Whiteness
A	25 μ	98
B	2.2 μ	100
C	2.2 μ	98
D	0.5 μ	99
E	0.2 μ	99

The results, together with the results of a field effect test, etc. described later, show that there are the relations between the reflectance and the repelling effect, and when the reflectance is 900 or more, this method has a practically excellent effect of preventing the damage from thrips. Powder B which appears the whitest to the naked eye was inferior in reflectance to powder C having the same particle diameter as that of powder B. This shows that the choice of the white fine

powder of mineral should be made depending upon the reflectance.

Furthermore, it also is shown that when the formulations are sprayed at the solid concentration of 2 kg or less per 40 liters of water, it is preferred as a conclusion that the reflectance of citrus leaves is 900 or more, because a solid concentration of 2 kg or more per 40 liters of water may exert a physiologically bad effect on citrus leaves.

TEST EXAMPLE 2

In order to examine the ratio of a white fine mineral powder to a fixing agent, 50, 100, 150, and 200 grams of formulation B in Example 1 mixed with 1 kg of formulation A were added to 40 liters of water to prepare the spraying liquids, respectively, and the reflectance was measured in the same manner as described above. In addition, to examine the resistance to rain, an artificial rain treatment of 90 mm in total over 2 hours was carried out. Results are shown in Table 2.

Table 2

Per 40 Liters of Water	I	II	III	IV
Formulation A of Example 1	1 Kg	1 Kg	1 Kg	1 Kg
Formulation B of Example 1	50 g	100 g	150 g	200 g
Adhesion Properties Before Rain	○	○	○	○
Reflectance Before Rain	○	○	○~△	△~×
Fixing Properties After Rain	△	○	○	○
Reflectance After Rain	○	○	○~△	△~×

Notes) ○: Excellent △: Good ×: Poor

From the results described above, it has been found that a small ratio of the fixing agent causes deterioration in resistance

to rain, but a large ratio thereof adversely results in a decrease in reflectance. The presumable reason for this is that particles are covered with film of the fixing agent to reduce reflecting areas. This relation is schematically shown in Figs. 2 (1), (2) and (3).

TEST EXAMPLE 3

Fifty trees a ward of a decennial ordinary citrus unshiu were tested, and the sample formulations were sprayed in sufficient quantities by use of a power spraying machine on July 9 and on August 24, Orthoran diluted 1500 times was similarly sprayed on June 15 and on July 28, and Mikantop diluted 1000 times was sprayed on October 1, respectively. The damage from thrips were examined on October 26 at the top and calyx portions of fruits and the extent of the damage was divided into four grades of 0 to 3 for evaluation (random sampling of three trees a ward and 30 fruits a tree). Results are shown in Table 3. Additionally, rainfall within a test period also is recorded in Table 4.

Table 3

Formulations	Dilution	Top Portion of Fruit				Calyx Portion of Fruit			
		Number of Damaged Fruits Divided by Grades				Number of Damaged Fruits Divided by Grades			
		0	1	2	3	0	1	2	3
Example 3	40	50	27	3	0	59	28	1	2
M Daifer Wettable Powder	500	40	41	9	0	52	32	6	0
No Prevention		6	36	31	17	17	60	13	0
LSD(10%)									
LSD(5%)									

Top Portion of Fruit		Calyx portion of Fruit	
Degree of Damage	Ratio of Damaged Fruits	Degree of Damage	Ratio of Damaged Fruits
8.5	44.4	7.96	34.4
12.6	55.6	9.26	42.2
42.8	93.3	18.33	81.1
10.42	17.54	4.22	8.01
12.92	22.12	5.23	9.93

Notes

Ratio of Damaged Fruits = [(Total Number of Fruits - N(0))/ (Total Number of Fruits)] x 100

Degree of Damage = [(N(1)x1+N(2)x3+N(3)x6)/ (Total Number of Fruits x 6)] x 100

(Herein, N(i) indicates the number of damaged fruits of grade i)

Table 4

Rainfall (mm)	6/12	6/13	7/8	7/10	7/13	8/15	8/16	9/10	9/11
	16	75	7	1	1	140	111	6	29

The Test Example 3 shows that Example 3 exhibits a higher repelling effect than that in wards having undergone no prevention operation, and a repelling effect similar to that

of M Daifer wettable powder of reference which was diluted 500 times has been confirmed.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a characteristic diagram of reflectance of the formulations used in the method of the present invention. Figs. 2 (1), (2) and (3) are showing the relation between the quantity of a fixing agent and the reflectance.

Fig. 1

(1) Reflectance

(2) Concentration

Fig. 2

(1) Fine Particles of Mineral

(2) Fixing Agent

(3) Reflectance

(4) Fixing Properties